Great Plains Research 12 (Spring 2002): 123-39

HABITAT CONSERVATION FOR BIRDS IN THE MISSISSIPPI HEADWATERS/TALLGRASS PRAIRIE ECOSYSTEM

Rolf Koford and **Heidi Stallman**[1]
Iowa Cooperative Fish and Wildlife Research Unit
Biological Resources Division, U.S.G.S.
5 Science Hall II
Iowa State University
Ames, IA 50011-3221

ABSTRACT — Land management agencies need to plan and prioritize their activities to best use limited resources. To implement ecosystem management, the US Fish and Wildlife Service has defined watershed-based planning units, such as the Mississippi Headwaters/Tallgrass Prairie Ecosystem. To identify important habitats for migratory birds in this ecosystem, we ranked habitats according to their importance for breeding birds of conservation concern, using rankings of the birds' conservation priority within this ecosystem. Grasslands and wetlands were the highest ranked habitats because 12 (46%) and 9 (25%), respectively, of the species breeding in these habitats had "Partners in Flight" scores greater than 19 (maximum 35). Shrub-sapling stands and lake habitats ranked next, and forest habitats ranked lowest. The four highly ranked habitats are widespread in the Great Plains. These habitats can contribute to the conservation of a variety of high-priority bird species, if the habitats are restored and managed for birds.

KEY WORDS: declining species, grassland birds, habitats, restoration, wetlands

[1] Current address: 2801 W. Broadway, K-4, Columbia, MO 65203.

Introduction

Many bird species are declining throughout their breeding ranges and therefore are of concern to resource managers (e.g., Office of Migratory Bird Management 1995). Although declines in neotropical migrant bird populations have received the most attention recently (Askins et al. 1990; Witham and Hunter 1992; Robbins et al. 1993; Thompson et al. 1993; Knopf 1994; Herkert 1995; Vickery et al. 1999), populations of many short-distance migrants, permanent residents, and game birds have also declined

(Vance 1976; Robbins et al. 1986; Leedy 1987; Hussell et al. 1992). To reverse these trends and to facilitate conservation of declining species, resource managers are developing management plans that seek to benefit these species as well as nondeclining species. Time and money are limited, however, and what is good for one species may not be as good for others. Management plans that focus on important habitats may be easier to implement than plans that focus on many individual species (e.g., Tome et al. 1994).

Most species have primary habitats where abundance and reproductive success are highest. An obvious way to manage for a species of concern is to concentrate on the management of its primary habitat. Although a species may use other habitats to varying degrees, managing these other habitats for the species of concern might have little effect on the total population, while it could be harmful to other species for which the area is primary habitat. This is especially true for birds that are habitat specialists and breed successfully in only one habitat type. Although we know that some species require habitat mosaics or may benefit from secondary habitats, a focus on habitat specialists is initially justified because many declining species are habitat specialists.

After high-priority species and their primary habitats are identified, it is important to prioritize these habitats within the larger landscape. Although it would be ideal to manage all habitats well, this may not be feasible. Limited funds and time may force resource managers to choose which habitats will be managed and how intensive that management will be. By prioritizing habitats according to the number of species of concern that use that habitat, management efforts and resources can be concentrated on the habitats and species of highest concern.

A habitat approach to managing for species of concern could initiate a reversal in the population declines that many bird species have experienced in the past decades. For this approach to work, managers in each region of the country must identify the priority species and their primary habitats, devise plans for each habitat considering all species of concern, and work together to coordinate their management plans. Our aim was to facilitate a habitat approach for birds in the US Fish and Wildlife Service-defined Mississippi Headwaters/Tallgrass Prairie Ecosystem (Fig. 1). For simplicity, we will refer to the Mississippi Headwaters/Tallgrass Prairie Ecosystem as the Headwaters Ecosystem. First, we arranged all breeding bird species in the Headwaters Ecosystem in decreasing order of concern using the prioritization scheme suggested by "Partners in Flight," an international

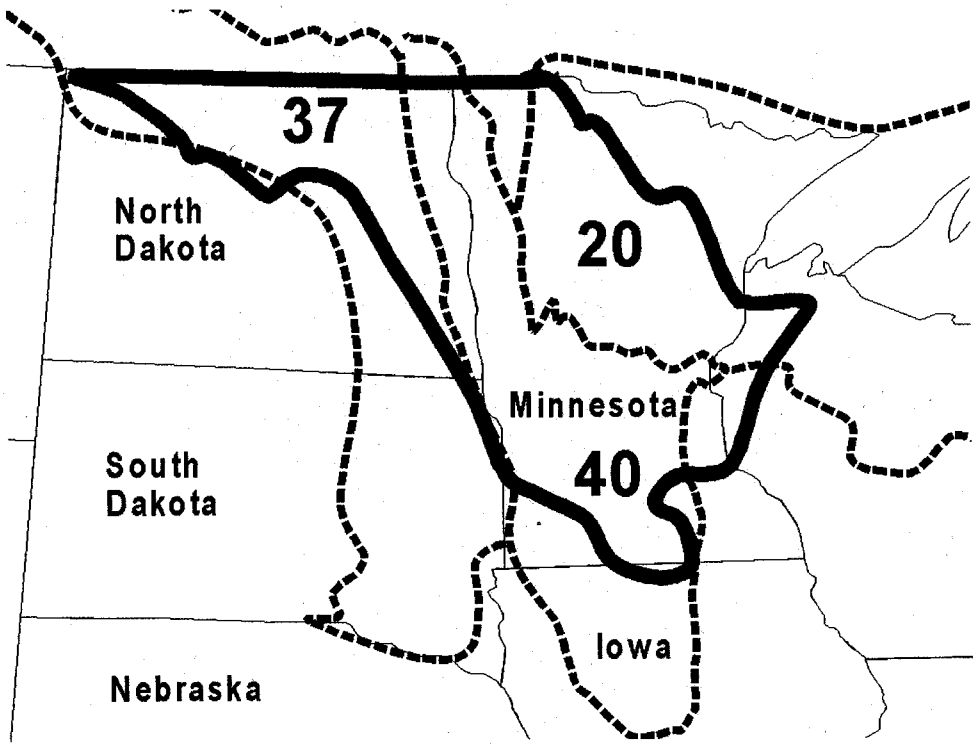

Figure 1. Approximate boundaries of the Mississippi Headwaters/Tallgrass Prairie Ecosystem (bold line) and three Partners in Flight areas (separated by dashed lines): northern mixed-grass prairie (area 37), northern tallgrass prairie (area 40), and boreal hardwood transition (area 20).

program that has identified sensitive species and is developing conservation plans for each habitat where they occur (Carter et al. 2000). Second, we ranked all major habitats in the Headwaters Ecosystem in decreasing order of importance, according to the number of high-priority breeding bird species. Third, we listed a few key references that give specific management recommendations for the highest-priority habitats.

Methods

The Headwaters Ecosystem includes the St. Croix River basin of Wisconsin and four major drainage basins in Minnesota and North Dakota: the Red River of the North, the Upper Mississippi River, the Minnesota River, and the St. Croix River basins (Fig. 1). This ecosystem incorporates four major biomes: tallgrass prairie, mixed-grass prairie, eastern deciduous

TABLE 1

HABITATS FOR BREEDING BIRDS IN THE HEADWATERS ECOSYSTEM

Habitat	Abbreviation	Definition
Lake	Lake	Great Lakes or inland lakes or streams with deep open water including shores and island woods
Wetland	Wetland	Sedge meadow, fen, ponds, marshes
Agricultural-Woodland edge	AgEdge	Woody fencerows, shelterbelts, orchards, forest edges in agricultural landscapes
Grassland	Grass	Prairie, pasture, Conservation Reserve Program (CRP), herbaceous roadsides, hayfields, cultivated fields
Shrub-sapling	Shrub	Shrub swamp, upland old field, seedling-sapling forest <12 years old
Lowland coniferous	LowCon	Semi-open to closed coniferous lowland forest including spruce swamps
Lowland deciduous	LowDec	Semi-open to closed canopy bottomland deciduous forest
Young deciduous	YngDec	Small trees in upland deciduous forest 12-30 years old
Mature deciduous	MatDec	Mature, upland deciduous forest >30 years old
Young coniferous	YngCon	Small trees in upland coniferous forest 12-30 years old
Mature coniferous	MatCon	Upland coniferous forest >30 years old
Bank-ledge	Bank	Ledges, cliffs, caves, banks, etc.
Developed	Developed	Urban, suburban, rural development

Modified from Thompson et al. (1993).

forest, and northern coniferous forest. It provides habitat for over 200 breeding bird species.

We identified 14 primary habitats in the Headwaters Ecosystem (Table 1). All bird species with documented breeding in at least one county within the Headwaters Ecosystem since 1970 (1950 for North Dakota), and with "Partners in Flight" scores for the relevant physiographic areas, were assigned a primary breeding habitat based on published literature and personal observation (Stewart 1975; Janssen and Simonson 1984a, 1984b,

1985; Janssen 1987; Coffin and Pfannmuller 1988; Green 1991; Robbins 1991; Winker et al. 1992; Thompson et al. 1993; Best et al. 1995). A few species use multiple habitats extensively. For example, Le Conte's sparrow (*Ammodramus leconteii*) is traditionally considered a wetland species (e.g., Ehrlich et al. 1988), but it has become more common in grasslands (Igl and Johnson 1995). Assignment of primary habitat in these few cases had to be based on judgment.

"Partners in Flight" developed conservation-concern scores by assigning each bird species a score ranging from 1 to 5, for each of seven criteria (1 = low/widespread to 5 = high/restricted). These criteria were global abundance, breeding distribution, winter distribution, severity of threats on the wintering grounds and migration routes, severity of threats on the breeding grounds, importance of the physiographic area to the species, and population trend in that area based on the Breeding Bird Survey data (Carter et al. 2000). Species were ranked based on the sum of the seven scores and divided into five concern classes: high priority (total score $\geq$23), priority (20 - 22), concern (17 - 19), low priority (14 - 16), and no priority (<14).

We used the Partners in Flight scores for the boreal hardwood transition (area 20), northern mixed-grass prairie (area 37), and northern tallgrass prairie (area 40) physiographic areas to rank breeding bird species (Fig. 1; see http://www.partnersinflight.org/pifbcps.htm). These areas have been modified from the physiographic strata defined for the Breeding Bird Survey (Robbins et al. 1986). Scores for the northern tallgrass prairie (area 40 in Fig. 1) were used if they were available since most of that area was within the Headwaters Ecosystem. Some species were not abundant enough to be scored for that area because they had eastern or western affinities. For these species, we used scores from either the boreal hardwood transition or the northern mixed-grass prairie, as appropriate. This use of three sources captured the species' priority in the Headwaters Ecosystem as a whole. Averaging was not an option because not all species were scored in all three areas. We obtained scores from the Partners in Flight Bird Conservation Plans for the northern mixed-grass prairie and northern tallgrass prairie physiographic areas (Fitzgerald et al. 1998, 1999), and draft scores for the boreal hardwood transition physiographic area from Jane Fitzgerald, former Partners in Flight Midwest Regional Coordinator (May 2000). Scores for other species were obtained from the Colorado Bird Observatory (http://www.cbobirds.org/pif/, updated October 1998).

We ranked habitats in descending order of importance, based on the number of species in the highest concern class for each primary habitat. Other ranking schemes could have been used, but most would have resulted

in identification of the same top four habitats. Our intent was to distinguish major differences in rank, not to discriminate between habitats of similar rank. We used these ranks to make specific recommendations for the highest-priority habitats and species. When possible, studies within the north-central United States (Minnesota, Wisconsin, North Dakota, South Dakota, and Iowa) were used for management recommendations and habitat preferences. Although some species are consistently associated with the same habitat variables (Noon et al. 1980), many species use habitats differently, have different habitat preferences, or respond to management practices differently in different geographic areas (e.g., Collins 1983a, 1983b; Kantrud and Kologiski 1983; Shy 1984). However, when sufficient information was not available from the north-central United States, we used studies from Missouri, Nebraska, Illinois, the Michigan Upper Peninsula, and south-central Canada as well.

Results

Priority Habitats

A total of 239 species bred in the Headwaters Ecosystem and met our inclusion criteria, including 30 resident species, 31 migratory species that develop some resident populations, 13 migratory species for which the region is primarily a migration stopover, 162 migratory species that breed extensively in the Headwaters Ecosystem, and 2 recently reintroduced species. The species of greatest management concern (Table 2) were greater prairie-chicken (*Tympanuchus cupido*), Sprague's pipit (*Anthus spragueii*), golden-winged warbler (*Vermivora chrysoptera*), cerulean warbler (*Dendroica cerulea*), Nelson's sharp-tailed sparrow (*Ammodramus nelsoni*), Baird's sparrow (*A. bairdii*), Henslow's sparrow (*A. henslowii*), and McCown's longspur (*Calcarius mccownii*). Seventeen species (7%) were classified as "high priority" (score $\geq$23), 32 species (13%) as "priority" (score = 20-22), and 63 species (26%) as "concern" (score = 17-19) (Tables 2, 3).

Grassland Birds

Grassland was the highest-priority habitat in the Headwaters Ecosystem with 12 of 26 breeding species (46%) in the "high priority" or "priority" classes concern of (Table 3). This habitat had twice as many species (6) in the "high priority" class as any other habitat. The "high priority" species

TABLE 2
BREEDING BIRD SPECIES OF GREATEST CONCERN IN THE HEADWATERS ECOSYSTEM, THEIR HABITATS AND CONSERVATION STATUS

Species	Habitat[a]	Score[b]
"High-priority" status		
Greater prairie-chicken (*Tympanuchus cupido*)	Grass	28
Baird's sparrow (*Ammodramus bairdii*)	Grass	28[c]
Golden-winged warbler (*Vermivora chrysoptera*)	Shrub	27[d]
Nelson's sharp-tailed sparrow (*Ammodramus nelsoni*)	Wetland	27
McCown's longspur (*Calcarius mccownii*)	Grass	27[c]
Sprague's pipit (*Anthus spragueii*)	Grass	26[c]
Cerulean warbler (*Dendroica cerulea*)	MatDec	26
Henslow's sparrow (*Ammodramus henslowii*)	Grass	26
Trumpeter swan (*Cygnus buccinator*)	Lake	25
Yellow rail (*Cotumicops noveboracensis*)	Wetland	25
Piping plover (*Charadrius melodus*)	Lake	25[c]
Sedge wren (*Cistothorus platensis*)	Wetland	24
Canada warbler (*Wilsonia canadensis*)	MatCon	24[d]
Hooded merganser (*Lophodytes cucullatus*)	Lake	23
Black-billed cuckoo (*Coccyzus erythropthalmus*)	YngDec	23
Bell's vireo (*Vireo bellii*)	Shrub	23
Bobolink (*Dolichonyx oryzivorus*)	Grass	23
"Priority" status		
American black duck (*Anas rubripes*)	Wetland	22[d]
Ferruginous hawk (*Buteo regalis*)	Grass	22[c]
Marbled godwit (*Limosa fedoa*)	Lake	22
Franklin's gull (*Larus pipixcan*)	Lake	22
Red-headed woodpecker (*Melanerpes erythrocephalus*)	MatDec	22
Marsh wren (*Cistothorus palustris*)	Wetland	22
Black-throated blue warbler (*Dendroica nigrescens*)	MatDec	22[d]
Prothonotary warbler (*Protonotaria citrea*)	LowDec	22
Louisiana waterthrush (*Seiurus motacilla*)	LowDec	22
Dickcissel (*Spiza americana*)	Grass	22
Le Conte's sparrow (*Ammodramus leconteii*)	Wetland	22
Chestnut-collared longspur (*Calcarius ornatus*)	Grass	22
Sandhill crane (*Grus canadensis*)	Wetland	21
American avocet (*Recurvirostra americana*)	Lake	21
Long-billed curlew (*Numenius americanus*)	Grass	21[c]
Blue-winged warbler (*Vermivora pinus*)	Shrub	21
Connecticut warbler (*Oporornis agilis*)	LowCon	21[d]
American white pelican (*Pelecanus erythrorhynchos*)	Lake	20
Wood duck (*Aix sponsa*)	LowDec	20
Canvasback (*Aythya valisineria*)	Wetland	20
Upland sandpiper (*Bartramia longicauda*)	Grass	20
Wilson's phalarope (*Phalaropus tricolor*)	Wetland	20
Whip-poor-will (*Caprimulgus vociferus*)	YngDec	20
Black-backed woodpecker (*Picoides arcticus*)	MatCon	20[d]

TABLE 2 continued

Species	Habitat[a]	Score[b]
Olive-sided flycatcher (*Contopus borealis*)	MatCon	20[d]
Wood thrush (*Hylocichla mustelina*)	MatDec	20
Chestnut-sided warbler (*Dendroica pensylvanica*)	Shrub	20[d]
Blackburnian warbler (*Dendroica fusca*)	MatCon	20
Mourning warbler (*Oporornis philadelphia*)	Shrub	20[d]
Hooded warbler (*Wilsonia citrina*)	MatDec	20[d]
Lark bunting (*Calamospiza melanocorys*)	Grass	20[c]
Purple finch (*Carpodacus purpureus*)	LowCon	20[d]

Note: Species are listed according to their high Partners in Flight scores (>19) and taxonomic order (American Ornithologists' Union 1998).
[a] Primary breeding habitats are defined in Table 1.
[b] Scores are based on the Partners in Flight prioritization scheme (http://www.partnersinflight.org/) and are for the northern tallgrass prairie (area 40 in Fig. 1) unless otherwise noted.
[c] Score is for the northern mixed-grass prairie (area 37 in Fig. 1).
[d] Score is for the boreal hardwood transition (area 20 in Fig 1)

included greater prairie-chicken, Baird's sparrow, McCown's longspur, Sprague's pipit, Henslow's sparrow, and Bobolink (*Dolichonyx oryzivorus*) (Table 2).

Wetland Birds

Wetlands include wet meadows, fens, beaver ponds, and temporary, seasonal, semipermanent, and permanent marshes, and are roughly equivalent in priority to shrub-sapling stands and lake habitats (Table 3). More species (36), including nine "high priority" and "priority" species (Table 2), use wetlands as their primary breeding habitat than any other habitat type in the Headwaters Ecosystem.

Lake Birds

Lake habitat in the Headwaters Ecosystem includes the Great Lakes, as well as inland lakes, ponds, or streams with deep, open water and their

TABLE 3

DISTRIBUTION OF BIRD SPECIES AMONG CONCERN CLASSES IN HABITATS OF THE HEADWATERS ECOSYSTEM

Habitat	High Priority	Priority	Concern	Low Priority	No Priority	Total species
Grassland	6 (23%)	6 (23%)	8 (31%)	4 (15%)	2 (8%)	26
Wetland	3 (8%)	6 (17%)	8 (22%)	11 (31%)	8 (38%)	36
Lake	3 (9%)	4 (12%)	7 (21%)	12 (36%)	7 (21%)	33
Shrub	2 (9%)	3 (13%)	5 (22%)	9 (39%)	4 (17%)	23
Mature Deciduous	1 (3%)	4 (13%)	10 (33%)	11 (37%)	4 (47%)	30
Mature Coniferous	1 (4%)	3 (11%)	9 (33%)	10 (37%)	4 (15%)	27
Young Deciduous	1 (14%)	1 (14%)	3 (43%)	1 (14%)	1 (14%)	7
Low Deciduous	-	3 (38%)	1 (13%)	3 (38%)	-	7
Low Coniferous	-	2 (18%)	3 (27%)	3 (27%)	3 (27%)	11
Ag Edge	-	-	5 (24%)	5 (24%)	11 (52%)	21
Developed	-	-	3 (30%)	2 (20%)	5 (50%)	10
Bank Ledge	-	-	1 (50%)	1 (50%)	-	2
All Forests	-	-	-	2 (50%)	2 (50%)	4
Young Coniferous	-	-	-	1 (50%)	1 (50%)	2
Total	17	32	63	75	52	239

Note: Number of species and percentage of the total species in each habitat. Habitats are defined in Table 1. Concern classes scores are "high priority" $\geq$ 23; "priority" 20 - 22; "concern" 17 - 19; "low priority" 14 - 16; "no priority" $\leq$ 13.0. Dashes indicate no species of that concern class was found in that habitat.

adjacent shores and islands. Lakes host 33 primary breeding species, including seven "high priority" and "priority" species (Table 2). Many lake species are often secretive in nature or sensitive to human disturbance; more information is needed to develop management strategies for the habitat.

Shrub-Sapling Birds

A total of 23 species use shrub-sapling stands as their primary habitat, 5 of which are "high priority" or "priority" species (Table 2). Similar to grassland and wetland specialists, shrub specialists depend on a habitat that is transitory: it becomes unsuitable in a few years without periodic disturbance or management.

Young Deciduous Forest Birds

The young deciduous habitat class was ranked in the middle (Table 3) and hosted only 7 species. The fact that such a high percentage (28%) of these species were in the "high priority" and "priority" classes (Table 2), however, indicates that this habitat or these species should be given management attention. The black-billed cuckoo (*Coccyzus erythropthalmus*) requires a dense, well-developed shrub layer and lower canopy for feeding and nest sites. It does not require large areas of contiguous young deciduous habitat, but it is sensitive to habitat isolation and avoids small patches if other suitable habitat is not nearby (Robbins et al. 1989).

Discussion

The spatial heterogeneity of the Headwaters Ecosystem undoubtedly contributed to the large number of breeding bird species (239) we analyzed. The highest-priority habitat revealed by our ranking criteria was prairie grassland, followed by wetlands, shrub-sapling, and lakes. Nearly half of the breeding species in the Headwaters Ecosystem were of relatively high management concern: 17 (7%) in "high priority," 32 (13%) in "priority," and 63 (26%) in "concern" categories. Historical management of waterfowl in the western part of the Headwaters Ecosystem has provided habitat for both grassland and wetland species because upland cover has been managed along with wetlands (Johnson 1996).

Grassland Birds

Factors responsible for the decline in populations of grassland birds are not entirely understood. However, they are most likely a combination of loss and degradation of grassland habitat, reproductive failure due to high rates of nest predation and nest parasitism, pesticide contamination, and shifts in agricultural practices, such as increasing area in rowcrop production and earlier and more frequent mowing of hayfields (Rodenhouse et al. 1993; Herkert et al. 1993; Herkert 1994; Vickery et al. 1999). To retain the diversity of grassland bird species in the Headwaters Ecosystem, management could be intensified and land-use practices modified to include more open grassland.

Management for grassland birds is complex. Since grasslands depend on some disturbance to persist (Samson and Knopf 1996), habitat suitable for a bird species in one year may become unsuitable by the next year.

Moreover, each grassland species has specific habitat requirements (e.g., Johnson and Igl 2000), and management that favors one species may preclude another. Guidelines for managing grassland bird habitats have been developed to simplify interpretation (Sample and Mossman 1997; Fitzgerald et al. 1998, 1999; Johnson and Igl 2000).

Wetland Birds

Habitat loss is cited as the main reason for the population decline of most wetland species (e.g., Howe 1987; Krapu and Duebbert 1989; Gibbs et al. 1992; Murkin 1998). Wetlands have been extensively converted for agricultural use in the Headwaters Ecosystem and only a small fraction of pre-European-settlement wetlands still remains (Dahl 1990). Habitat degradation also reduces population numbers by reducing resources. Eutrophication, siltation, chemical contamination, and human disturbance seriously reduce habitat quality, primarily by degrading food supply, even on large, protected wetlands (Gibbs et al. 1992). To manage wetland species effectively, managers must both provide more wetland habitat and protect habitat quality in existing wetland complexes (Krapu and Duebbert 1989; Reid 1993).

Wetlands cannot be separated from their adjacent uplands in an effective management plan. Dabbling ducks feed in wetlands but usually nest in upland grassland (Kantrud 1986). Certain shorebirds, such as Wilson's phalarope (*Phalaropus tricolor*) and the marbled godwit (*Limosa fedoa*), likewise require both terrestrial and aquatic habitats (Ehrlich et al. 1988). American bitterns (*Botaurus lentiginosus*) and northern harriers (*Circus cyaneus*) will nest in either emergent wetland vegetation or in dense upland vegetation (Ehrlich et al. 1988). Yellow-headed blackbirds (*Xanthocephalus xanthocephalus*) nest in wetlands but often forage in terrestrial habitats (personal observation). Some species, such as Le Conte's sparrow (*Ammodramus leconteii*), take advantage of wet periods to invade upland grass-forb plantings (Igl and Johnson 1995). Thus, management recommendations for wetlands must include the entire prairie-wetland complex. Furthermore, management for wildlife cannot compromise other wetland functions and values, such as nutrient cycling (Murkin 1998).

Lake Birds

Lake species have a range of preferred habitat characteristics, although most need a large amount of open water within a grassland/shrub

environment. Only the hooded merganser (*Lophodytes cucullatus*) requires forested landscapes around lakes (Ehrlich et al. 1988). Most lake species are also extremely sensitive to human disturbance, especially at the nest site. Those that are not sensitive to direct disturbance are often negatively affected by the increased predation, habitat loss, or pollution that accompanies human development (Gibbs et al. 1992).

Shrub-Sapling Birds

The population declines in shrubland species may reflect the loss of shrubby old fields in the Headwaters Ecosystem associated with increased efficiency in agriculture, trends towards reforestation, and urban/suburban growth (Confer 1992; Askins 1993). Loss of shrub habitat may also have occurred on managed lands, if managers view shrub-sapling habitat as just a transition between the more desirable habitats, grassland and forest. Conservation of shrubland specialist species may require deliberate management to maintain or create suitable shrub-sapling habitat.

Shrub species are not as area sensitive as many forest or grassland species of concern (Askins 1993). These species can occur in shrub-grass, shrub-wood, or shrub-riparian habitats. General overviews can be found in references on forest birds, such as Green (1995).

Young Deciduous Forest Birds

Most young deciduous habitat is a successional stage after forest clearcuts or abandonment of agricultural fields. Habitat quality would be enhanced in patches cut for timber by letting stand the residual live trees, all dead trees, and all shrubs and saplings (Niemi and Hanowski 1984; Green 1995).

Conclusions

Recent conservation planning has recognized the importance of wetland and grassland habitats (e.g., Fitzgerald et al. 1998, 1999) even though lists of Partners in Flight "priority" species may be different from those reported here. Sandhill cranes (*Grus canadensis*), for example, are not listed as "priority" species in the northern mixed-grass prairie or northern tallgrass prairie physiographic areas (Fitzgerald et al. 1998, 1999). However, we put them in the "priority" class because their score was 21 (Table 2). The

habitats that we found to be of lesser priority are still essential for the species that inhabit them (e.g., Niemi and Hanowski 1984; Herkert et al. 1993; Green 1995).

The Great Plains still contain representative areas of the four habitats we ranked highest: prairie grassland, wetlands, shrub-sapling stands, and lakes. These habitats are important throughout the Plains. Restoration and thoughtful management of these habitats will benefit the species most in need of conservation attention in a Northern Plains ecosystem.

Acknowledgments

We appreciate the support and guidance of Steve Lewis and Lynn Lewis, US Fish and Wildlife Service. John Sauer, Patuxent Wildlife Research Center (Biological Resources Division, US Geological Survey), analyzed Breeding Bird Survey data for the Headwaters Ecosystem. Bonnie Bowen, James Dinsmore, anonymous reviewers, and the editor provided helpful suggestions on the manuscript.

References

American Ornithologists' Union. 1998. *Checklist of North American Birds.* Lawrence, KS: Allen Press.

Askins, R.A. 1993. Population trends in grassland, shrubland, and forest birds in eastern North America. *Current Ornithology* 11:1-34.

Askins, R.A., J.F. Lynch, and R. Greenberg. 1990. Population declines in migratory birds in eastern North America. *Current Ornithology* 7:1-57.

Best, L.B., K.E. Freemark, J.J. Dinsmore, and M. Camp. 1995. A review and synthesis of habitat use by breeding birds in agricultural landscapes of Iowa. *American Midland Naturalist* 134:1-29.

Carter, M.F., W.C. Hunter, D.N. Pashley, and K.V. Rosenberg. 2000. Setting conservation priorities for landbirds in the United States: The Partners in Flight approach. *Auk* 117:541-48.

Coffin, B., and L. Pfannmuller, eds. 1988. *Minnesota's Endangered Flora and Fauna.* Minneapolis: University of Minnesota Press.

Collins, S.L. 1983a. Geographic variation in habitat structure of the black-throated green warbler (*Dendroica virens*). *Auk* 100:382-89.

Collins, S.L. 1983b. Geographic variation in habitat structure for the wood warblers in Maine and Minnesota. *Oecologia* 59:246-52.

Confer, J.L. 1992. Golden-winged warbler. In *The Birds of North America*, no. 20, ed. A. Poole, P. Stettenheim, and F. Gill. Philadelphia: Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union.

Dahl, T.E. 1990. *Wetlands Losses in the United States 1780's to 1980's*. Washington, DC: US Fish and Wildlife Service.

Ehrlich, P.R., D.S. Dobkin, and D. Wheye. 1988. *The Birder's Handbook*. New York: Simon and Schuster.

Fitzgerald, J.A., D.N. Pashley, S.J. Lewis, and B. Pardo. 1998. *Partners in Flight Bird Conservation Plan for the Northern Tallgrass Prairie (Physiographic Area 40)*. Columbia, MO: Partners in Flight. Retrieved 15 May 2000, (http://www.blm.gov/wildlife/plan/pl_40all.pdf).

Fitzgerald, J.A., D.N. Pashley, and B. Pardo. 1999. *Partners in Flight Bird Conservation Plan for the Northern Mixed-Grass Prairie (Physiographic Area 37)*. Columbia, MO: Partners in Flight. Retrieved 19 May 2000, (http://www.blm.gov/wildlife/plan/pl_37_10.pdf).

Gibbs, J.P., S. Melvin, and F.A. Reid. 1992. American bittern. In *The Birds of North America*, no. 18, ed. A. Poole, P. Stettenheim, and F. Gill. Philadelphia: Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union.

Green, J.C. 1991. A landscape classification for breeding birds in Minnesota: An approach to describing regional biodiversity. *Loon* 63:80-91.

Green, J.C. 1995. *Birds and Forests: A Management and Conservation Guide*. St. Paul: Minnesota Department of Natural Resources.

Herkert, J.R. 1994. The effects of habitat fragmentation on midwestern grassland bird communities. *Ecological Applications* 4:461-71.

Herkert, J.R. 1995. An analysis of midwestern breeding bird population trends: 1966-1993. *American Midland Naturalist* 134:41-50.

Herkert, J.R., R.E. Szafoni, V.M. Kleen, and J.E. Schwegman. 1993. *Habitat Establishment, Enhancement, and Management for Forest and Grassland Birds in Illinois*. Natural Heritage Technical Publication no. 1, Division of Natural Heritage, Illinois Department of Conservation.

Howe, M.A. 1987. Wetlands and waterbird conservation. *American Birds* 41:204-9.

Hussell, D.J.T., M.H. Mather, and P.H. Sinclair. 1992. Trends in numbers of tropical- and temperate-wintering migrant landbirds in migration at Long Point, Ontario. In *Ecology and Conservation of Neotropical Migrant Landbirds*, ed. J.M. Hagan and D.W. Johnston, 101-14. Manomet, MA: Manomet Bird Observatory.

Igl, L.D., and D.H. Johnson. 1995. Dramatic increase of Le Conte's sparrow in Conservation Reserve Program fields in the northern Great Plains. *Prairie Naturalist* 27:89-94.

Janssen, R.B. 1987. *Birds in Minnesota.* Minneapolis: University of Minnesota Press.

Janssen, R.B., and G. Simonson. 1984a. Minnesota's breeding bird distribution. *Loon* 56:167-86.

Janssen, R.B., and G. Simonson. 1984b. Minnesota's breeding bird distribution (pt. 2). *Loon* 56:219-39.

Janssen, R.B., and G. Simonson. 1985. Minnesota's breeding bird distribution (pt. 3). *Loon* 57:15-34.

Johnson, D.H. 1996. Management of northern prairies and wetlands for the conservation of neotropical migratory birds. In *Management of Midwestern Landscapes for the Conservation of Neotropical Migratory Birds*, ed. F.R. Thompson III, 53-67. USDA Forest Service General Technical Report NC-187.

Johnson, D.H., and L.D. Igl, series coord. 2000. *Effects of Management Practices on Grassland Birds.* Jamestown, ND: Northern Prairie Wildlife Research Center. Retrieved 20 May 2000, http://www.npwrc.usgs.gov/resource/literatr/grasbird/grasbird.htm (version 17FEB2000).

Kantrud, H.A. 1986. *Effects of Vegetation Manipulation on Breeding Waterfowl in Prairie Wetlands: A Literature Review.* US Fish and Wildlife Service Fish and Wildlife Technical Report 3:1-15

Kantrud, H.A., and R.L. Kologiski. 1983. Avian associations of the Northern Great Plains grasslands. *Journal of Biogeography* 10:331-50.

Knopf, F.L. 1994. Avian assemblages on altered grasslands. *Studies in Avian Biology* 15:247-57.

Krapu, G.L., and H.F. Duebbert. 1989. Prairie wetlands: characteristics, importance to waterfowl, and status. In *Freshwater Wetlands and Wildlife*, eds. R.R. Sharitz and J.W. Gibbons, 811-28.

Leedy, D.L. 1987. *The Ohio Pheasant Range Revisited.* Columbus: Ohio Department of Natural Resources.

Murkin, H.R. 1998. Freshwater functions and values of prairie wetlands. *Great Plains Research* 8:3-15.

Niemi, G.J., and J.M. Hanowski. 1984. Relationships of breeding birds to habitat characteristics in logged areas. *Journal of Wildlife Management* 48:438-43.

Noon, B.R., D.K. Dawson, D.B. Inkley, C.S. Robbins, and S.H. Anderson. 1980. Consistency in habitat preference of forest bird species. *Transactions of the North American Wildlife and Natural Resources Conference* 45:226-44.

Office of Migratory Bird Management. 1995. *Migratory Nongame Birds of Management Concern in the United States: The 1995 List.* Washington, DC: US Fish and Wildlife Service.

Reid, F.A. 1993. Managing wetlands for waterbirds. *Transactions North American Wildlife and Natural Resources Conference* 58:345-50.

Robbins, C.S., D. Bystrak, and P.H. Geissler. 1986. The Breeding Bird Survey: Its first fifteen years, 1965-1979. *US Fish and Wildlife Service Resource Publication* 157.

Robbins, C.S., D.K. Dawson, and B.A. Dowell. 1989. Habitat area requirements of breeding forest birds of the middle Atlantic states. *Wildlife Monographs* 103:1-34.

Robbins, C.S., J.R. Sauer, and B.G. Peterjohn. 1993. Population trend and management opportunities for neotropical migrants. In *Status and Management of Neotropical Migratory Birds*, ed. D. Finch and P. Stangel, 17-23. USDA Forest Service General Technical Report RM-229.

Robbins, S.D. Jr. 1991. *Wisconsin Birdlife: Population and Distribution Past and Present.* Madison: University of Wisconsin Press.

Rodenhouse, N.L., L.B. Best, R.J. O'Connor, and E.K. Bollinger. 1993. Effects of temperate agriculture on neotropical migrant landbirds. In *Status and Management of Neotropical Migratory Birds*, ed. D. Finch and P. Stangel, 280-95. USDA Forest Service General Technical Report RM-229.

Samson, F.B., and F.L. Knopf., eds. 1996. *Prairie Conservation: Preserving North America's Most Endangered Ecosystem.* Washington, DC: Island Press

Sample, D.W., and M.J. Mossman. 1997. *Managing Habitat for Grassland Birds: A Guide for Wisconsin.* Madison, WI: Department of Natural Resources.

Shy, E. 1984. Habitat shift and geographical variation in North American tanagers (Thraupinae: *Piranga*). *Oecologia* 63:281-85.

Stewart, R.E. 1975. *Breeding Birds of North Dakota.* Fargo, ND: Tri-College Center for Environmental Studies.

Thompson, F.R. III, S.J. Lewis, J. Green, and D. Ewert. 1993. Status of neotropical migrant landbirds in the Midwest: Identifying species of management concern. In *Status and Management of Neotropical Migratory Birds*, ed. D. Finch and P. Stangel, 145-58. USDA Forest Service General Technical Report.

Tome, M.W., D. Helmers, and L.J. Niles. 1994. Managing habitats to avoid game and nongame conflicts. *Transactions of the North American Wildlife and Natural Resources Conference* 59:348-52.

Vance, D.R. 1976. Changes in land-use and wildlife populations in southeastern Illinois. *Wildlife Society Bulletin* 4:11-15.

Vickery, P.D., P.L. Tubaro, J.M. Cardosa da Silva, B.G. Peterson, J.R. Herkert, and R.B. Cavalcanti. 1999. Conservation of grassland birds in the western hemisphere. *Studies in Avian Biology* 19:2-26.

Winker, K., D.W. Warner, and A.R. Weisbrod. 1992. Migration of woodland birds at a fragmented stopover site. *Wilson Bulletin* 104:580-98.

Witham, J.W., and M.L. Hunter Jr. 1992. Population trends of neotropical migrant landbirds in northern coastal New England. In *Ecology and Conservation of Neotropical Migrant Landbirds*, ed. J.M. Hagan and D.W. Johnston, 85-95. Manomet, MA: Manomet Bird Observatory.